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## High-speed policy-based packet forwarding using efficient multi-dimensional range matching

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**Authors** [T. V. Lakshman](#)  
[D. Stiliadis](#)

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### ↑ ABSTRACT

The ability to provide differentiated services to users with widely varying requirements is becoming increasingly important, and Internet Service Providers would like to provide these differentiated services using the same shared network infrastructure. The key mechanism, that enables differentiation in a connectionless network, is the packet classification function that parses the headers of the packets, and after determining their context, classifies them based on administrative policies or real-time reservation decisions. Packet classification, however, is a complex operation that can become the bottleneck in routers that try to support gigabit link capacities. Hence, many proposals for differentiated services only require classification at lower speed edge routers and also avoid classification based on multiple fields in the packet header even if it might be advantageous to service providers. In this paper, we present new packet classification schemes that, with a worst-case and traffic-independent performance metric, can classify packets, by checking amongst a few thousand filtering rules, at rates of a million packets per second using range matches on more than 4 packet header fields. For a special case of classification in two dimensions, we present an algorithm that can handle more than 128K rules at these speeds in a traffic independent manner. We emphasize worst-case performance over average case performance because providing differentiated services requires intelligent queueing and scheduling of packets that precludes any significant queueing before the differentiating step (i.e., before packet classification). The presented filtering or classification schemes can be used to classify packets for security policy enforcement, applying resource management decisions, flow identification for RSVP reservations, multicast look-ups, and for source-destination and policy based routing. The scalability and performance of the algorithms have

been demonstrated by implementation and testing in a prototype system.

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## Packet classification on multiple fields

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**Authors** [Pankaj Gupta](#)  
[Nick McKeown](#)

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### ↑ ABSTRACT

Routers classify packets to determine which flow they belong to, and to decide what service they should receive. Classification may, in general, be based on an arbitrary number of fields in the packet header. Performing classification quickly on an arbitrary number of fields is known to be difficult, and has poor worst-case performance. In this paper, we consider a number of classifiers taken from real networks. We find that the classifiers contain considerable structure and redundancy that can be exploited by the classification algorithm. In particular, we find that a simple multi-stage classification algorithm, called RFC (recursive flow classification), can classify 30 million packets per second in pipelined hardware, or one million packets per second in software.

### ↑ REFERENCES

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1 [Mikael Degermark , Andrej Brodnik , Svante Carlsson , Stephen Pink, Small forwarding tables for fast routing lookups, Proceedings of the ACM SIGCOMM '97 conference on Applications, technologies, architectures, and protocols for computer communication, p.3-14, September 14-18, 1997, Cannes, France](#)